HUAWEI MG323 GSM M2M Module

Hardware Guide

Issue 04

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About This Document

History

Version	Date	Chapter	Descriptions
01			Creation
02	2010-10-25	1	Deleted “1.2 Related Documents”
		3.1	Deleted “Charging Interface (TBD)”
		3.6.1	Revised “Table 3-5 UART1 interface signals”
		3.8	Deleted “Charging Interface (TBD)” Added “Audio Interface”
		7	Revised “Figure 7-1 Circuits of typical interfaces in the MG323 module”
03	2011-07-18	2.2	Add authentication information-CCC、GCF and mode of audio services
		3.5.2	Add the maximum time of TERM_ON
		3.6	Add signal of the RING while receiving a message and a voice call
		5.2	Revised “Table 5-1 Extreme working conditions for the MG323 module”
		5.4	Revised “Table 5-3 Sequence numbers of pins and definitions of signals on the B2B interface” and “Table 5-4 Electrical features of application interfaces”
		5.5.2	Revised “Table 5-6 Working current of the MG323 module”
		6.3	Specify the mode of the 50-pin B2B connector
04	2011-08-22	3.2	Revised “Figure 3-1 Sequence and definitions of pins on the B2B signal interface”
		6.4	Revised “Figure 6-5 Structure fixing hole”

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1 Introduction

1.1 Overview

This document describes the hardware application interfaces and air interfaces that are provided when the Huawei MG323 GSM M2M module (hereinafter referred to as the MG323 module) is used.

This document helps you to understand the interface specifications, electrical features, and related product information of the MG323 module.

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2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the MG323 module and provides:

- Function Overview
- Application Block Diagram
- Circuit Block Diagram

2.2 Function Overview

Table 2-1 Feature

Feature	Description
Working bands	Four supported frequency bands: GSM850 MHz/900 MHz/1800 MHz/1900 MHz
Maximum transmission power	GSM850 Class 4 (2 W)
	EGSM900 Class 4 (2 W)
	GSM1800 Class 1 (1 W)
	GSM1900 Class 1 (1 W)
Receiver sensitivity	< –107 dBm
Working temperature	Normal working temperature: –20°C to + 70°C
	Extreme working temperatures: – 30°C to – 20°C and + 70°C to + 75°C
Ambient temperature for storage	– 40°C to 85°C
Power voltage	3.3 V to 4.8 V (3.8 V is recommended.)

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Feature	Description		
Power consumption (current)	Power-off current: 47 µA		
	Average standby current	DRX = 2	< 3.0 mA
		DRX = 5	< 2.5 mA
		DRX = 9	< 2.0 mA
	GPRS Class 10 (maximum): 460 mA		
Protocols	GSM/GPRS Phase2/2+		
AT commands	See the *HUAWEI MG323 GSM M2M Module AT Command Interface Specification*.		
Application interface (50-pin B2B connector)	UART1 (supporting 8-wire UART)		
	One standard Subscriber Identity Module (SIM) card interface (3 V or 1.8 V)		
	Interfaces for two analog audio channels		
	Power Interface		
	Network status light-emitting diode (LED) control interface		
Antenna interface	Hirose U.FL-R-SMT-1(80) 50 ohm antenna connector		
	Antenna pad		
Voice services	Two analog voice channels		
SMS	New message alert, text message receiving, and text message sending		
	Management of text messages: read messages, delete messages, storage status, and message list		
	Support for the protocol data unit (PDU) mode		
GPRS	GPRS CLASS 10		
	Encoding schemes: CS 1, CS 2, CS 3, and CS 4		
	Maximum downlink transmission rate: 85.6 kbps		
	Maximum uplink transmission rate: 42.8 kbps		
	Packet Broadcast Control Channel (PBCCH)		
	Embedded with TCP/IP protocols, supporting multiple links		
Circuit Switched Data (CSD) data services	CSD data services at the maximum rate of 9.6 kbit/s		
Physical features	• Dimensions (L × W × H): 35 mm × 32.5 mm × 3.05 mm • Weight: 5.8 g		

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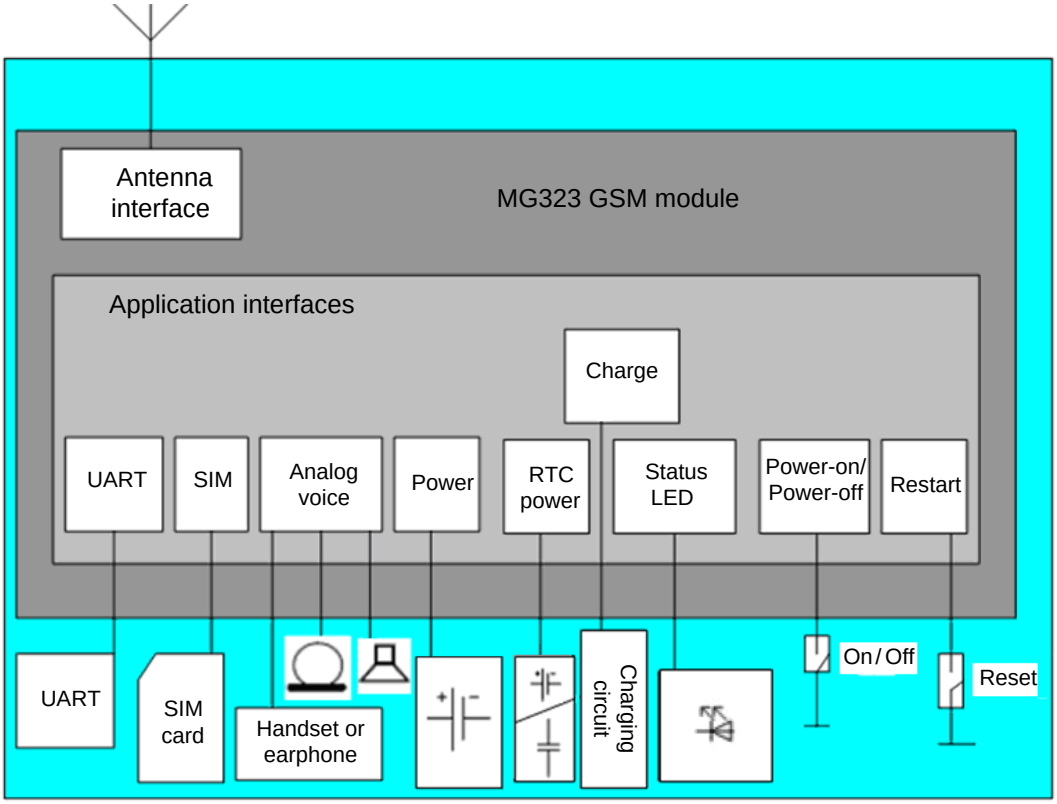
Feature	Description
Certification information	Restriction of the use of certain Hazardous Substances (RoHS), European Conformity (CE), Federal Communications Commission (FCC), CMIIT, China Compulsory Certification (CCC), GCF (GSM Certification Forum)

2.3 Application Block Diagram

Figure 2-1 shows the application block diagram of the MG323 module.

Figure 2-1 Application block diagram of the MG323 module



2.4 Circuit Block Diagram

The circuit block diagram and major functional units of the MG323 module contain the following parts:

- GSM baseband controller
- Power management
- Multi-chip package (MCP) memory

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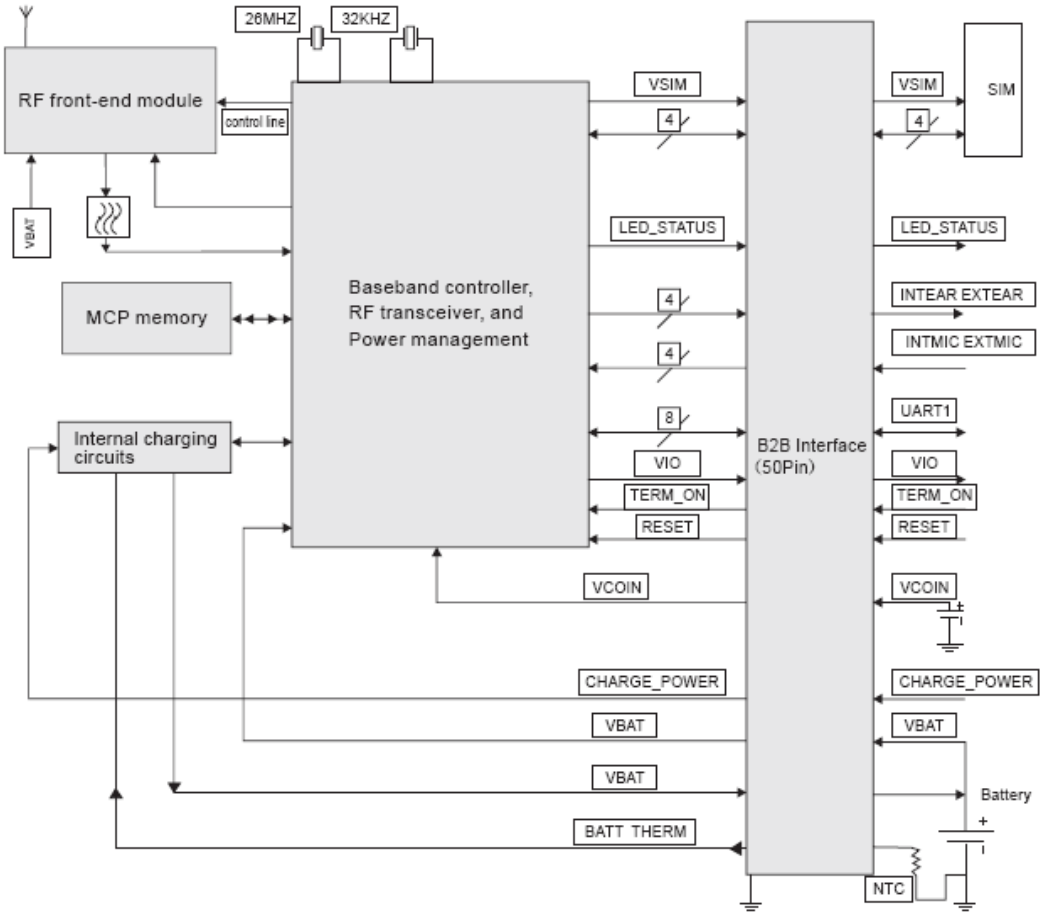
- Radio frequency (RF) transceiver
- 26 MHz reference clock
- RF front-end modules
- Receive filter

Figure 2-2 Circuit block diagram of the MG323 module



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3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MG323 module, including:

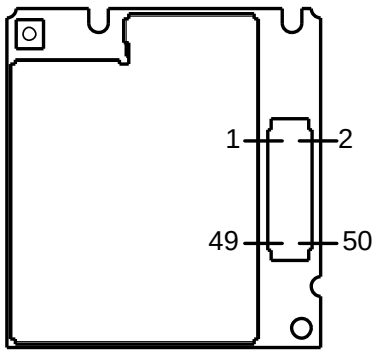
- B2B Connector Interface
- Power Interface
- Power-On and Power-Off Time Sequence
- Signal Control Interface
- UART Interface
- SIM Card Interface
- Audio Interface

3.2 B2B Connector Interface

The MG323 module uses a 50-pin B2B connector as its external interface. For details about the model and dimensions of the B2B connector, see “6.3 Dimensions of the B2B Connector."

Figure 3-1 shows the sequence and definitions of pins on the 50-pin B2B signal interface of the MG323 module.

Figure 3-1 Sequence and definitions of pins on the B2B signal interface



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PIN NO.	Signal name	PIN NO.	Signal name
1	SIM_CLK	2	INTEAR_N
3	VSIM	4	INTEAR_P
5	SIM_DATA	6	EXTEAR_P
7	SIM_RST	8	EXTEAR_N
9	NC	10	INTMIC_N
11	GND	12	INTMIC_P
13	NC	14	EXTMIC_P
15	NC	16	EXTMIC_N
17	NC	18	GND
19	NC	20	TERM_ON
21	NC	22	RESET
23	BATT_THERM	24	UART1_DCD
25	LED_STATUS	26	NC
27	NC	28	UART1_CTS
29	UART1_RD	30	NC
31	NC	32	UART1_DTR
33	UART1_TD	34	UART1_RTS
35	VCOIN	36	UART1_DSR
37	NC	38	UART1_RING
39	NC	40	VIO
41	GND	42	VBAT
43	GND	44	VBAT
45	GND	46	VBAT
47	GND	48	VBAT
49	GND	50	VBAT

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3.3 Power Interface

3.3.1 Overview

The power supply part of the B2B interface of the MG323 module contains:

- VBAT interface for the power supply
- VCOIN interface for the standby power supply of the real-time clock (RTC)
- VIO interface for external power output

Table 3-1 lists the definitions of the pins on the power supply interface.

Table 3-1 Definitions of the pins on the power supply interface

Pin No.	Signal Name	I/O	Description
42, 44, 46, 48, 50	VBAT	P	Pins for power voltage input
41, 43, 45, 47, 49	GND	-	GND
35	VCOIN	P	Pin for standby power input of the RTC
40	VIO	P	Pin for external power output

NOTE
P indicates power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output; **AI** indicates pins for analog signal input; **AO** indicates pins for analog signal input.

3.3.2 VBAT Interface

When the MG323 module works normally, power is supplied through the VBAT pins and the voltage ranges from 3.3 V to 4.8 V (typical value: 3.8 V). The 50-pin B2B connector provides five VBAT pins and five GND pins for external power input. To ensure that the MG323 module works normally, all the pins must be used efficiently.

When the MG323 module is used for different external applications, pay special attention to the design for the power supply. When the MG323 module transmits signals at the maximum power, the transient current may reach the transient peak value of about 2.0 A due to the differences in actual network environments. In this case, the VBAT voltage drops. Make sure that the voltage does not decrease below 3.3 V in any case. Otherwise, exceptions such as restart of the MG323 module may occur.

A low-dropout (LDO) regulator or switch power with current output of more than 2 A is recommended for external power supply. Furthermore, a 2.2 mF or above energy storage capacitor is connected in parallel at the power interface of the MG323 module. As for the energy storage capacitor, a 2.2 mF or above electrolytic capacitor is recommended. In addition, to reduce the impact of channel impedance on voltage drop, you are recommended to try to shorten the power supply circuit of the VBAT interface.

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NOTE

For detailed information about power supply design and printed circuit board (PCB) design, see *HUAWEI MI Module Power Management Design Guide*, *HUAWEI M2M Module Power Management Design Guide* and *HUAWEI LGA Module PCB Routing Design Guide.*

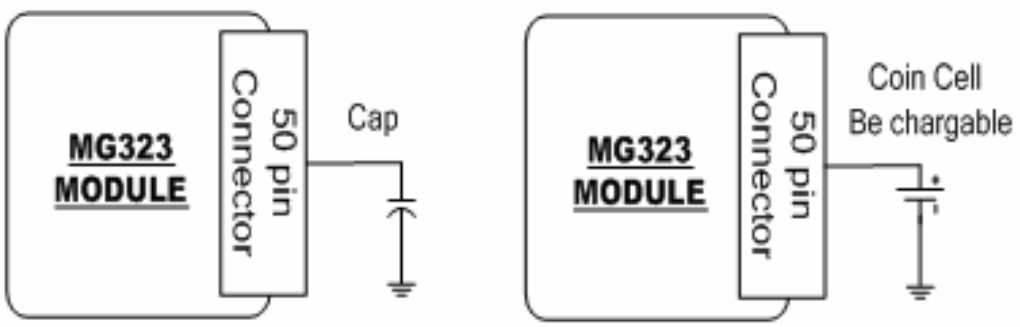
3.3.3 VCOIN Interface

VCOIN is an interface for standby power input of the RTC in the MG323 module. If the VBAT interface is ready for power supply, it on priority supplies the RTC with power. If the VBAT interface is not ready, the VCOIN interface provides standby power input for the RTC. In this case, the MG323 module needs 5 μA to maintain the RTC function.

You can use an external battery to supply power through the VCOIN interface. The recommended voltage is 3 V. You can also use an external capacitor if you do not use a battery. The capacitance determines the duration of the RTC when the VBAT interface is not ready.

The MG323 module supports charging external standby batteries. When the VBAT voltage is 3.8 V, the charging current is about 0.6 mA (typical value). Figure 3-2 shows two types of circuits for your reference.

Figure 3-2 VCOIN interface circuit



3.3.4 VIO Interface

Through the VIO interface, the MG323 module can supply 2.8 V power externally with an output current of 10 mA (typical value) for external level conversion or other applications.

If the MG323 module is in Sleep mode, the VIO interface is in the low power consumption state (< 500 μA). If the MG323 module is in Power Down mode, the VIO is in the disabled state. If VIO pin is not in use, disconnect the pin and make sure it is not grounded.

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3.4 Power-On and Power-Off Time Sequence

3.4.1 Overview

The power-on, power-off, and reset control parts of the B2B interface of the MG323 module includes power-on/power-off interface signal (TERM_ON) and the hardware reset interface signal (RESET). Table 3-2 lists the definitions of the interface pins.

Table 3-2 Definitions of pins of the power-on/power-off and reset interfaces

Pin No.	Signal Name	I/O	Description
20	TERM_ON	I	Pin for controlling power-on and power-off
22	RESET	I	Pin for resetting the hardware

3.4.2 Power-On Time Sequence

WARNING

- Make sure that the MG323 module is powered on at the voltage and working temperature in the recommended range. Otherwise, the module may get damaged or work improperly.
- External application interfaces must be powered on after the module is powered on.

You can power on the MG323 module through the TERM_ON interface. The software will report relevant information according to the actual settings after the module is powered on. For example, the AT command automatically reports **^SYSSTART**[1]. In this case, the external VIO interface is enabled and supplies 2.8 V power.

NOTE

[1] For specific setting information about the power-on/power-off software, see the *HUAWEI MG323 GSM M2M Module AT Command Interface Specification*.

Figure 3-3 shows the power-on time sequence.

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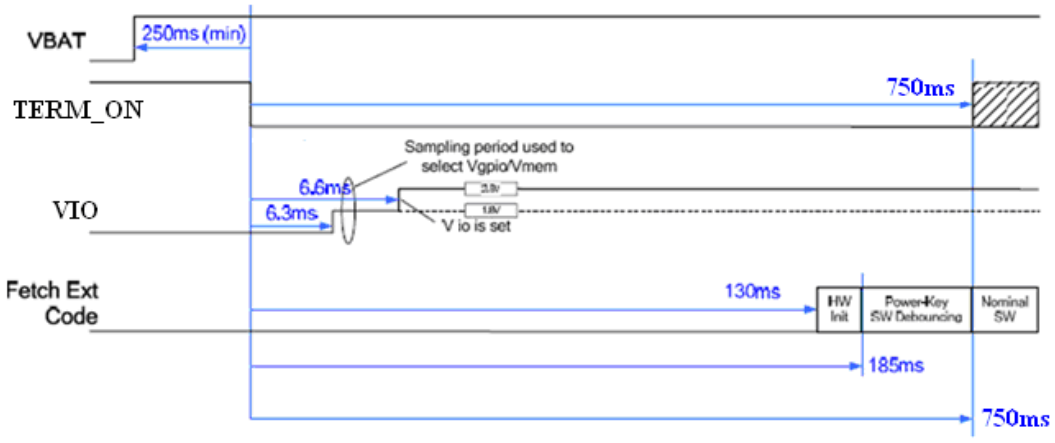
Figure 3-3 Power-on time sequence



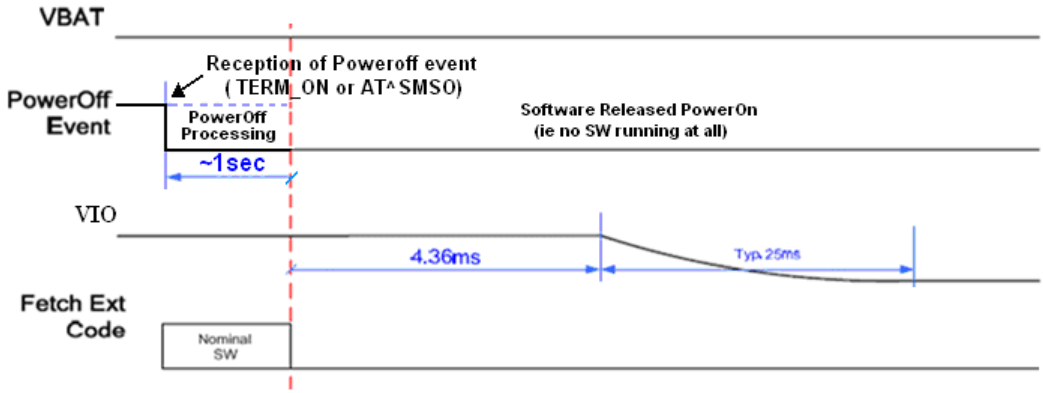
NOTE

Fetch Ext Code in the figure is a file system in the MG323 module.

3.4.3 Power-Off Time Sequence

The MG323 module supports power-off through the TERM_ON interface or the **AT^SMSO** command. Figure 3-4 shows the power-off time sequence.

Figure 3-4 Power-off time sequence



NOTE

The processing of the power-off event depends on the normal stop time of the file system in the MG323 module. The processing varies with the capacity of the file system.

3.4.4 RESET

The MG323 module supports hardware reset function. If the software of the MG323 module stops responding, you can reset the hardware through the RESET signal. After the hardware is reset, the software starts powering on the module and reports

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relevant information according to the actual settings. For example, the AT command automatically reports **^SYSSTART**. In this case, the external VIO interface is enabled and supplies 2.8 V power.

3.5 Signal Control Interface

3.5.1 Overview

The signal control part of the B2B interface in the MG323 module consists of:

- Power-on/off (TERM_ON) pin
- Hardware reset (RESET) pin
- Network status LED (LED_STATUS) pin

Table 3-3 lists the pins on the signal control interface.

Table 3-3 Pins on the signal control interface

Pin No.	Signal Name	I/O	Description
20	TERM_ON	I	Pin for controlling power-on and power-off
22	RESET	I	Pin for resetting the hardware
25	LED_STATUS	O	Pin for network status LED

3.5.2 Input Signal Control Pins

The MG323 module implements power-on and power-off and resets the hardware through the input signal control pins.

The TERM_ON pin is used to implement power-on and power-off. If the TERM_ON pin is pulled down for 1 second to 2 seconds, the module is powered on; if the TERM_ON pin is pulled down for 1 second to 2 seconds again, the module is powered off.

The RESET pin is used to reset the hardware. When the software stops responding, the RESET pin can be pulled down for at least 10 ms to reset the hardware.

CAUTION

As the RESET and TERM_ON signals are relatively sensitive, it is recommended that you install a 10 nF capacitor near the RESET and TERM_ON pins of the B2B interface for filtering. In addition, when you design a circuit on the PCB of the interface board, it is recommended that the circuit length not exceed 20 mm and that the circuit be kept at a distance of 2.54 mm (100 mil) at least from the PCB edge. Furthermore, you need to wrap the area adjacent to the signal wire with a ground wire. Otherwise, the module may be reset due to interference.

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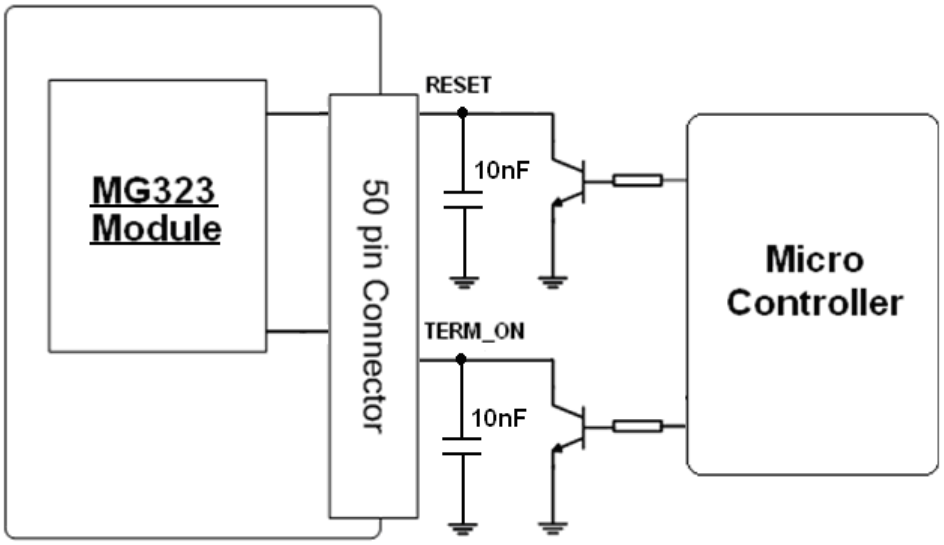
Figure 3-5 shows the connections of the TERM_ON and RESET pins.

Figure 3-5 Connections of the TERM_ON and RESET pins



3.5.3 Output Signal Control Pin

The MG323 module provides a network status LED pin LED_STATUS. The pulse signal output through this pin controls the status LED on the user interface board to display the network status.

Different blinking modes of the status LED indicate different network status. Table 3-4 describes the status of the LED_STATUS pin.

Table 3-4 Status of the LED_STATUS pin

Working or Network Status	Output Status of the LED_STATUS Pin
Sleep mode	A low-level signal is output continuously.
Network-searching or non-network status (including the case when the SIM card is not inserted and the case when the PIN number is unblocked)	A high-level signal is output for 0.1s in a period of 1s.
Registered with a 2G network	A high-level signal is output for 0.1s in a period of 3s.
GPRS data service	A high-level signal is output for 0.1s in a period of 0.125s.
Voice call	A high-level signal is output continuously.

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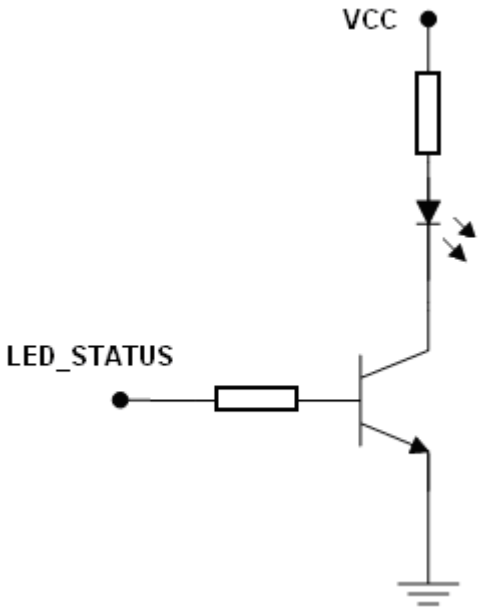
In practical application, the LED_STATUS pin cannot be directly used to drive the status LED. The LED_STATUS pin needs to be used with a triode. To select a suitable current-limiting resistor for the LED, check the actual voltage drop and rated current of the LED. Figure 3-6 shows the driving circuit.

Figure 3-6 Driving circuit



3.6 UART Interface

3.6.1 Overview

The MG323 module provides the RS-232 UART1 (8-wire UART) interface for one asynchronous communication channel. As the UART1 interface supports signal control through standard modem handshake, AT commands are entered and serial communication is performed through the UART1 interface. The UART1 has the following features:

- Full-duplex
- 7-bit or 8-bit data
- 1-bit or 2-bit stop bit
- Odd parity check, even parity check, or non-check
- Baud rate clock generated by the system clock
- Direct memory access (DMA) transmission
- Baud rate ranging from 600 bit/s to 230400 bit/s (115.2 kbit/s by default)
- Self-adapted baud rate ranging from 1200 bit/s to 115.2 kbit/s

Table 3-5 lists the UART1 interface signals.

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Table 3-5 UART1 interface signals

Pin No.	Signal Name	Description	Feature	Direction
29	UART1_RD	Data transmission end of the module	The data terminal equipment (DTE) receives serial data.	Data circuit-terminating equipment (DCE) to DTE
33	UART1_TD	Data receiving end of the module	The DTE transmits serial data.	DTE to DCE
38	UART1_RING	Ring indicator of the module	The DCE notifies the DTE of a remote call.	DCE to DTE
32	UART1_DTR	Data Terminal Ready	The DTE is ready.	DTE to DCE
34	UART1_RTS	Request To Send	The DTE requests the DCE to send data.	DTE to DCE
36	UART1_DSR	Data Set Ready	The DCE is ready.	DCE to DTE
28	UART1_CTS	Clear To Send	The DCE has switched to the data receiving mode.	DCE to DTE
24	UART1_DCD	Data Carrier Detect	A data link is set up.	DCE to DTE

3.6.2 Circuit Recommended for the UART Interface

Figure 3-7 shows the connection of the UART1 interface in the MG323 module (DCE) with the host (DTE).

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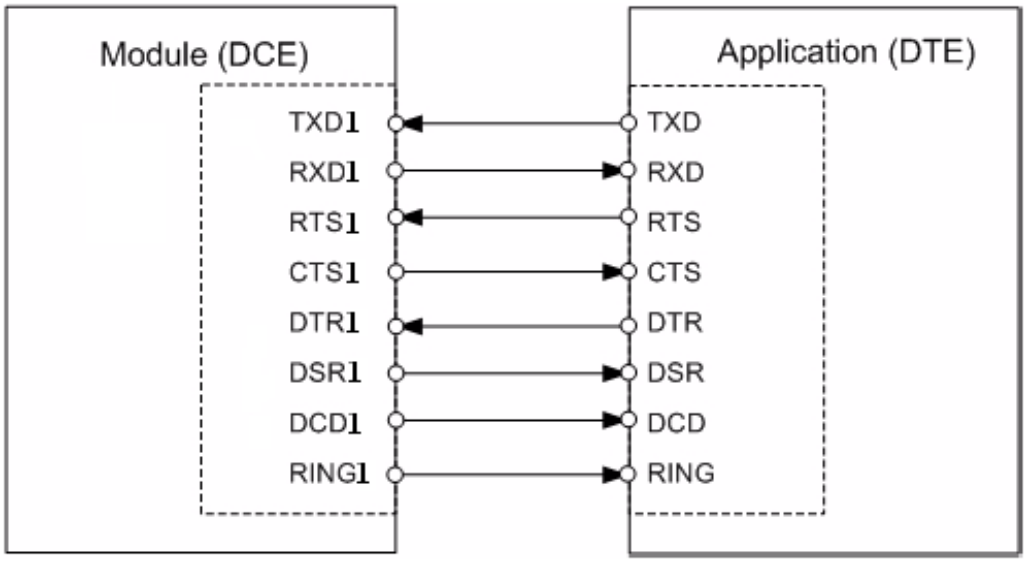
Figure 3-7 Connection of the UART1 interface in the MG323 module (DCE) with the host (DTE)



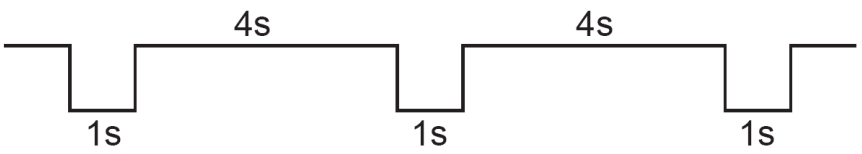
The RS-232 chip can be used to connect the MG323 GSM module to the RS-232-C interface. In this connection, the transistor-transistor logic (TTL) level and the Electronic Industries Association (EIA) level are converted mutually. For example, it is recommended that you use the MAX3232 chip with a 2-wire serial port and the SP3238 or MAX3238 chip with an 8-wire serial port.

When an MG323 module receives an SM (Short Message), a low-level signal is output through the RING (pin 38) for less than 1s, as shown in Figure 3-8 .

Figure 3-8 The signal through the RING after the MG323 receives an SM

When an MG323 Module receives a voice call, a periodical low level signal for 1s and a high level signal for 4s are output by RING, as shown in Figure 3-9 .

Figure 3-9 The signal through the /RING after the MG323 receives a voice call



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NOTE

For detailed application of the MG323 UART1 interface, see *HUAWEI Module UART Serial Port Design Guide*.

3.7 SIM Card Interface

3.7.1 Overview

The MG323 module provides a SIM card interface complying with the ISO 7816-3 standard and supports automatic detection of a 3.0 V SIM card or a 1.8 V SIM card. Table 3-6 lists the SIM card interface signals.

Table 3-6 SIM card interface signals

Pin No.	Signal Name	I/O	Description
1	SIM_CLK	O	Clock signal of the SIM card
3	VSIM	O	Power supply of the SIM card
5	SIM_DATA	I/O	Data signal of the SIM card
7	SIM_RST	O	Reset signal of the SIM card
11	GND		Ground signal of the SIM card

3.7.2 Circuit Recommended for the SIM Card Interface

As the MG323 module is not equipped with a SIM card socket, you need to place a SIM card socket on the user interface board. The SIM card signals are transmitted outwards through the 50-pin B2B connector interface. Figure 3-10 shows the circuit of the SIM card interface.

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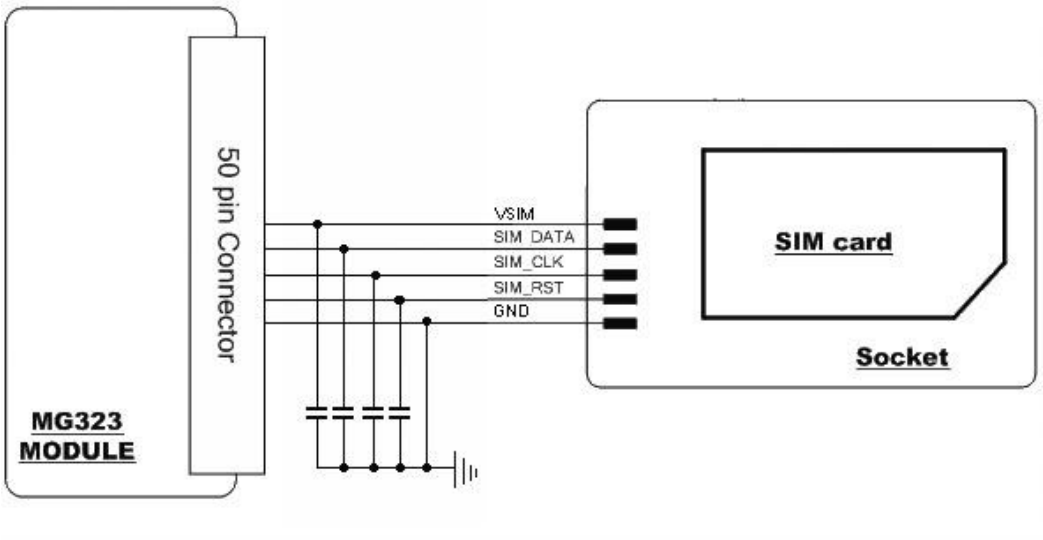
Figure 3-10 Circuit of the SIM card interface



CAUTION

- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the SIM card socket should be placed near the B2B connector interface (it is recommended that the PCB circuit connecting the B2B connector interface and the SIM card socket not exceed 100 mm), because a long circuit may lead to wave distortion, thus affecting signal quality.
- It is recommended that you wrap the area adjacent to the SIM_CLK and SIM_DATA signal wires with a ground wire. The GND pin of the SIM card socket and the GND pin of the SIM card must be well connected to the power GND pin supplying power to the MG323 module.
- A 0.1 µF capacitor or a 0.22 µF capacitor is placed between the VSIM and GND pins in parallel. Three 33 pF capacitors are placed between the SIM_DATA and GND pins, the SIM_RST and GND pins, and the SIM_CLK and GND pins in parallel to filter interference from RF signals.
- You do not need to pull the SIM_DATA pin up during design as a 15000-ohm resistor is used to connect the SIM_DATA pin to the VSIM pin.

3.7.3 ESD Protection for the SIM Card Interface

It is recommended that you take electrostatic discharge (ESD) protection measures near the SIM card socket. Figure 3-11 shows ESD protection circuit of the SIM card, in which the transient voltage suppressor (TVS) diode is placed as near as possible to the SIM card socket, and the GND pin of the ESD protection component is well connected to the power GND pin that supplies power to the MG323 module.

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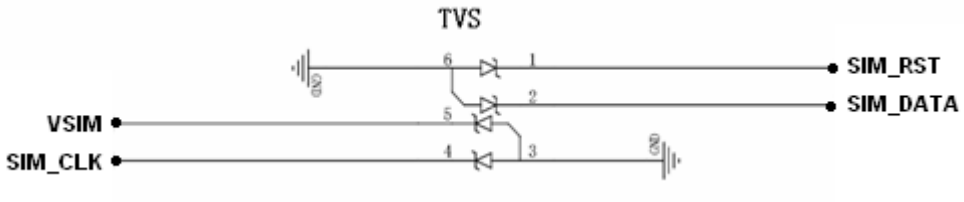
Figure 3-11 ESD protection circuit on the SIM card



3.8 Audio Interface

3.8.1 Overview

The MG323 module provides two types of audio interfaces: one is for handsets, the other is for headsets. The audio interfaces of the MG323 module support input from handset microphones and headset microphones, and provide output that supports 32 Ω handsets and 16 Ω headsets. Differential signal lines are recommended for the microphone interface and the speaker interface. Single-ended signal lines are not recommended. The reception gain can be adjusted by using software. A microphone with an equivalent load of 2.2 kΩ is recommended, because both the pull-up resistor and the pull-down resistor of the two types of differential signal lines for the microphone are 1 kΩ.

3.8.2 Speaker Interface

The MG323 module provides two types of audio interfaces that respectively support 32 Ω handsets and 16 Ω headsets. 33 pF capacitors are added for filtering radio frequency interference. Differential signal lines are recommended for the speaker interface. Consider the drive capability of the module when using a speaker with greater power.

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Figure 3-12 External circuit for 32 Ω handsets/16 Ω headsets

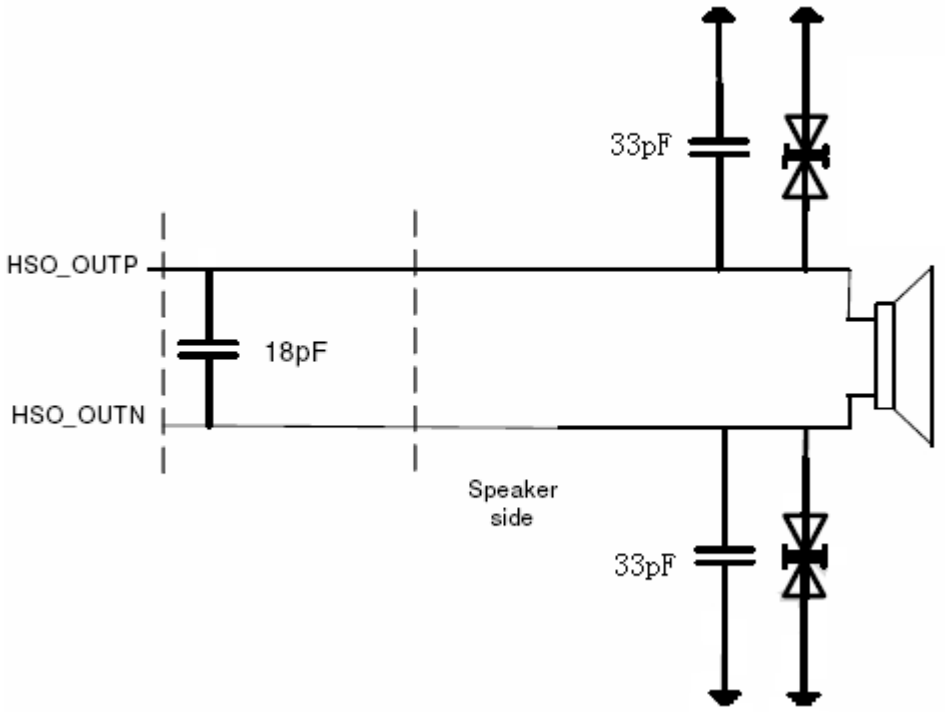

Table 3-7 Required speaker power for 32 Ω handsets/16 Ω headsets

Speaker Load	Total Harmonic Distortion	Power (Typical)
32 Ω (handset)	THD < 0.1%	91 mW
32 Ω (handset)	THD < 1%	96 mW
16 Ω (headset)	THD < 0.1%	127 mW
16 Ω (headset)	THD < 1%	144 mW

The specifications listed in Table 3-7 are based on the specified working temperature of the module.

3.8.3 Microphone Interface

A microphone with an equivalent load of 2.2 kΩ is recommended, because both the pull-up resistor and the pull-down resistor of the two types of differential signal lines for the microphone are 1 kΩ. It is recommended that ESD components and 33 pF capacitors be added to the interface to reduce radio frequency interference.

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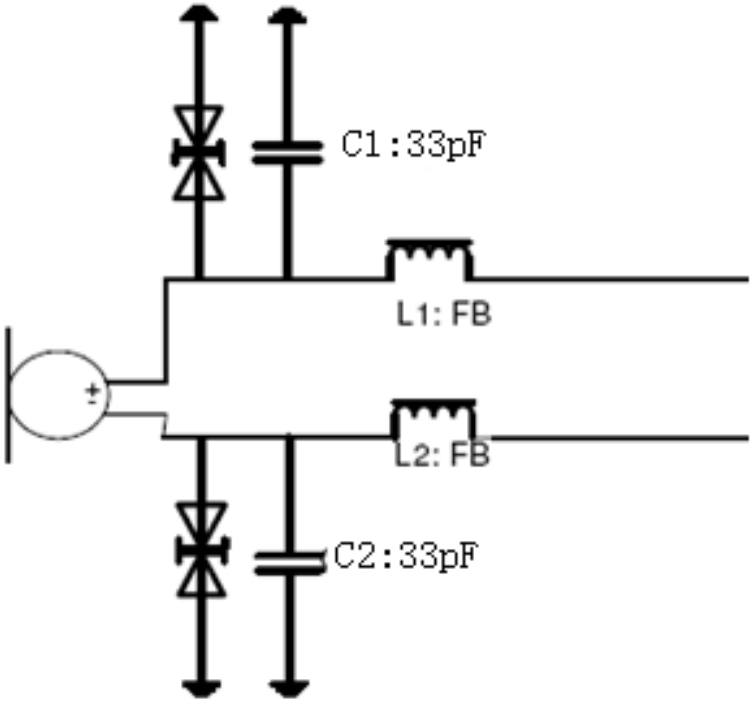
Figure 3-13 External circuit for the microphone interface



Total Harmonic Distortion	Internal Settings of the Module	Supported Input from Microphones
THD < 1%	F = 1kHz, pre-amp gain = 20dB, PGA gain = 14 dB	15.4 mV (typical)
THD < 5%	F = 1kHz, pre-amp gain = 0B, PGA gain = 0 dB	740 mV (typical)

The specifications listed in the preceding table are based on the ambient temperature ranging from −30°C to + 75°C when the module is working.

CAUTION

It is recommended that ESD components be added to the external circuit of the audio interface to protect the module.

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4 Antenna Interface

4.1 About This Chapter

An RF connector or an antenna pad can be used as the connection method of an antenna interface. When the MG323 module works properly, only one of the preceding connection methods is used. In addition, the antenna interface must be used with coaxial cables with 50 ohm characteristic impedance.

4.2 Antenna Installation

The MG323 module supports the following two antenna connection methods: buckled RF connector U.FL-R-SMT-1(80) manufactured by Hirose, and antenna pad. It is recommended that you use the buckled RF connector.

CAUTION

When the MG323 module works properly, only one antenna connection method can be used; otherwise, the RF performance may deteriorate.

If a buckled RF connector is used, it is recommended that you use a 50-ohm coaxial cable in the U.FL series. The height of the connector increases by 0.8 mm when this cable is used.

If an antenna pad is used, you need to connect the coaxial cable core to the pad. In addition, you need to connect the shield ground of the coaxial cable to the reference ground near the pad. You can choose a suitable direction to weld the RF cable to meet the installation requirements according to the actual application.

CAUTION

When trying to shorten the opening between the coaxial cable core and the shield ground, you also need to prevent a short circuit.

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The properties of major materials of the MG323 module are as follows:

- PCB: FR4
- Antenna pad: cheminal nickel-gold pad

4.3 Coaxial Cable and RF Connector

The U.FL-R-SMT-1(80) RF connector manufactured by Hirose is used as the antenna interface in the MG323 module. Figure 4-1 shows the RF connector dimensions.

Figure 4-1 RF connector dimensions

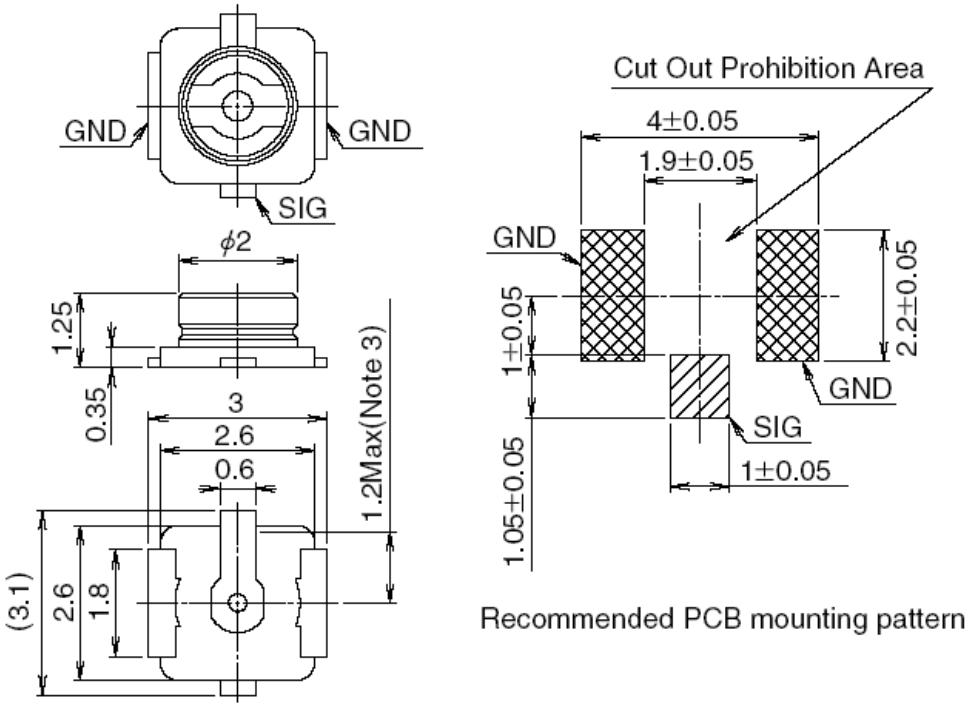

Table 4-1 lists the major specifications of the RF connector.

Table 4-1 Major specifications of the RF connector

Rated Condition		Environmental Condition		Type Material	
Frequency range	Direct current (DC) to 6 GHz	Temperature range	–40°C to +90°C	Shell	Phosphor and copper plated with silver
Characteristic impedance	50 ohms			Cable core	Gold-plated copper wire
				Insulating material	Socket: liquid crystal polyester (LCP)

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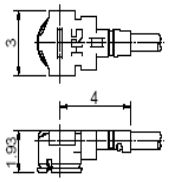
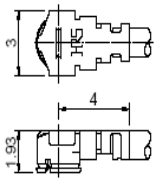
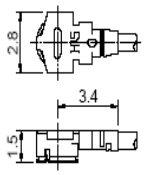
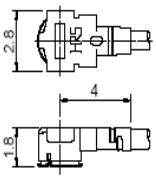
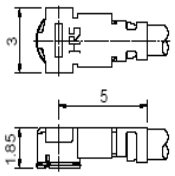
You can visit http://www.hirose.com for more information about the specifications of the U.FL-R-SMT-1(80) RF connector.

It is recommended that you use the Hirose coaxial cable with the RF connector. Figure 4-2 shows the specifications of the coaxial cable working with the RF connector.

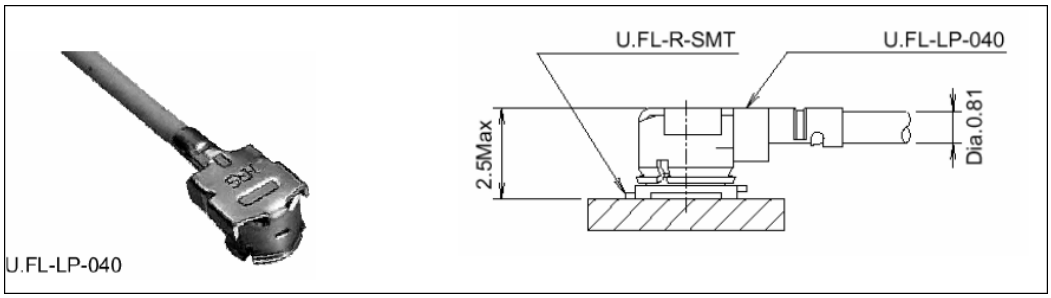
Figure 4-2 Specifications of the coaxial cable working with the RF connector

	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
Part No.					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 0.81mm Coaxial cable	Dia. 1mm Coaxial cable	Dia. 1.37mm Coaxial cable

You can visit http://www.hirose.com for more detailed information about the coaxial cable working with the RF connector.

Figure 4-3 shows the connection between the RF connector and the U.FL-LP-040 cable.

Figure 4-3 Connection between the RF connector and the U.FL-LP-040 cable



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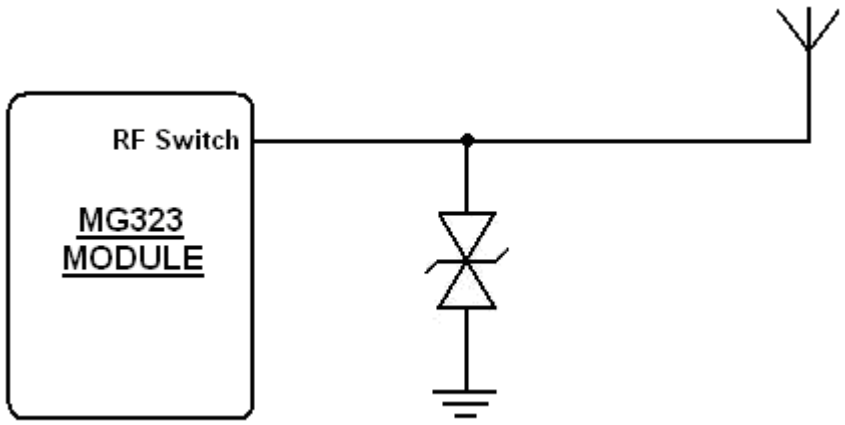
4.4 ESD Protection for the Antenna Interface

WARNING

In practical application, pay attention to the ESD protection for the antenna interface of the MG323 module. Incorrect operation may result in permanent damage to the RF components.

Figure 4-4 shows the ESD protection circuit recommended for the antenna interface.

Figure 4-4 ESD protection circuit recommended for the antenna interface



CAUTION

It is recommended that you pay attention to the junction capacitance of the TVS diode when you choose the model of the TVS diode. Ensure that the junction capacitance of the TVS diode is lower than 1 pF.

4.5 RF Specifications of the Antenna Interface

Table 4-2 lists the RF specifications of the antenna interface in the MG323 module.

Table 4-2 RF specifications of the antenna interface in the MG323 module

Specification		Minimum Value	Typical Value	Maximum Value	Unit
Uplink frequency range	GSM-850	824		849	MHz

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Specification		Minimum Value	Typical Value	Maximum Value	Unit
(Mobile station to base transceiver station)	EGSM-900	880		915	MHz
	GSM-1800	1710		1785	MHz
	GSM-1900	1850		1910	MHz
Downlink frequency range (Base transceiver station to mobile station)	GSM-850	869		894	MHz
	EGSM-900	925		960	MHz
	GSM-1800	1805		1880	MHz
	GSM-1900	1930		1990	MHz
Transmission power range	GSM-850	31	33	35	dBm
	EGSM-900	31	33	35	dBm
	GSM-1800	28	30	32	dBm
	GSM-1900	28	30	32	dBm
Number of carrier frequencies	GSM-850		124		
	EGSM-900		174		
	GSM-1800		374		
	GSM-1900		299		
Duplex spacing	GSM-850		25		MHz
	EGSM-900		45		MHz
	GSM-1800		95		MHz
	GSM-1900		60		MHz
Carrier spacing			200		kHz
Multiplex and duplex modes		Frequency division duplexing–time division multiple access (FDD-TDMA)			
Time slots of each TDMA frame			8		
Frame duration			4.615		ms
Time slot duration			577		µs
Modulation scheme		Gaussian minimum shift keying (GMSK)			
Receiver sensitivity	GSM-850		–108.5		dBm
	EGSM-900		–108.5		dBm
	GSM-1800		–108		dBm
	GSM-1900		–108		dBm

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4.6 Specifications of the Antenna Interface

Table 4-3 lists the recommended specifications of the antenna interface.

Table 4-3 Recommended specifications of the antenna interface

Working bands	824 MHz–960 MHz and 1710 MHz–1990 MHz
Port impedance	50 ohms
Voltage standing wave ratio (VSWR)	< 2.5
Maximum gain	> 0 dBi
Antenna efficiency	> 60%
Polarization	Linear polarization or circular polarization
Pattern	Omnidirectional

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5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the MG323 module, including:

- Extreme Working Conditions
- Working and Storage Temperatures and Humidity
- Electrical Criteria of Application Interfaces
- Power Supply Features
- Reliability Features
- ESD Features

5.2 Extreme Working Conditions

WARNING

Table 5-1 lists the extreme working conditions for the MG323 module. Using the MG323 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Extreme working conditions for the MG323 module

Symbol	Specification	Minimum Value	Maximum Value	Unit
VBAT	External power voltage	–0.4	6.0	V
VCOIN	Input voltage of standby power for the RTC	2.0	3.15	V
V_I	Data pin voltage	–0.4	3.3	V

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5.3 Working and Storage Temperatures and Humidity

Table 5-2 lists the working and storage temperatures and humidity for the MG323 module.

Table 5-2 Working and storage temperatures and humidity for the MG323 module

Specification	Minimum Value	Maximum Value	Unit
Normal working temperatures [1]	–20	+70	°C
Extreme working temperatures [2]	–30 to –20	+70 to +75	°C
Ambient temperature for storage	–40	+85	°C
Moisture	5	95	%

NOTE

[1]: When the MG323 module works at this temperature, all its RF indexes comply with the 3GPP TS 45.005 specifications.

[2]: When the MG323 module works at this temperature, certain RF indexes do not comply with the 3GPP TS 45.005 specifications.

5.4 Electrical Criteria of Application Interfaces

Table 5-3 lists the sequence numbers of pins and definitions of signals on the 50-pin B2B interface of the MG323 module.

Table 5-3 Sequence numbers of pins and definitions of signals on the B2B interface

Pin No.	Signal Name	Pin No.	Signal Name
1	SIM_CLK	2	INTEAR_N
3	VSIM	4	INTEAR_P
5	SIM_DATA	6	EXTEAR_P
7	SIM_RST	8	EXTEAR_N
9	NC	10	INTMIC_N
11	GND	12	INTMIC_P
13	NC	14	EXTMIC_P
15	NC	16	EXTMIC_N
17	NC	18	GND

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Pin No.	Signal Name	Pin No.	Signal Name
19	NC	20	TERM_ON
21	NC	22	RESET
23	BATT_THERM	24	UART1_DCD
25	LED_STATUS	26	NC
27	NC	28	UART1_CTS
29	UART1_RD	30	NC
31	NC	32	UART1_DTR
33	UART1_TD	34	UART1_RTS
35	VCOIN	36	UART1_DSR
37	NC	38	UART1_RING
39	NC	40	VIO
41	GND	42	VBAT
43	GND	44	VBAT
45	GND	46	VBAT
47	GND	48	VBAT
49	GND	50	VBAT

Table 5-4 lists electrical features (typical values) measured when no external device is connected to the MG323 module through the 50-pin B2B interface.

Table 5-4 Electrical features of application interfaces

Function	Signal Name	I/O	Waveform and Level	Remarks
Power supply interface	VBAT	P	V_I = 3.30 V to 4.80 V $V_I$type =3.80 V	Pins 42, 44, 46, 48, and 50 are power supply pins used to supply the MG323 module with power. When the module transmits signals at the maximum power, the transient current can reach about 2 A, which may result in VBAT voltage drop. The VBAT power voltage for the MG323 module should not be lower than 3.3 V.
	GND	P		Pins 41, 43, 45, 47, and 49 are power GND pins.

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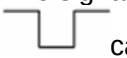
Function	Signal Name	I/O	Waveform and Level	Remarks
	BATT_ THERM	I		Pin 23 is used to check the battery temperature through a negative temperature coefficient (NTC) resistor. This pin can be left floating if it is not used.
External power voltage interface	VIO	P	V_{omin} = 2.70 V V_{otype} = 2.80 V V_{omax} = 2.95 V I_{omax} = 10.00 mA	Pin 40 is a pin for supplying external devices with power from the MG323 module. Ensure that the external peaks and burst do not damage the VIO interface. If the MG323 module is in Sleep mode, the VIO pin is in the enabled low consumption state (< 500 uA). If the MG323 module is in Power Down mode, the VIO pin is in the disabled state. This pin can be left floating if it is not used.
Interface for standby power input of the RTC	VCOIN	P	V_{omax} = 3.00 V V_{Imin} = 2.00 V V_{Itype} = 3.00 V V_{Imax} = 3.15 V I_{Itype} = 5.00 μA at VBAT = 0 V	Pin 35 is a pin for standby power input of the RTC. When the VBAT is not ready for power supply, the RTC can be supplied with power through an external coin battery or capacitor. This pin can be left floating if it is not used.
Power pin	TERM_ON	I	V_{ILmax} = 0.40 V The signal can be detected when low level keeps effective for one second or more.	Pin 20 is a pin for powering on the module. Low level is effective.
Reset pin	RESET	I	V_{ILmax} = 0.40 V The signal  can be detected when low level keeps effective for 10 milliseconds or more.	Pin 22 is a pin for restarting the module. Low level is effective. This pin can be left floating if it is not used.
Signal of the network status LED	LED_STATUS	O	V_{oHmin} = 2.70 V	Pin 25 is a pin for controlling the network status LED. This pin can be left floating if it is not used.
SIM card interface (assuming the voltage is 3.0	SIM_RST	O		Reset signal of the SIM card
	SIM_DATA	I/O		Data signal of the SIM card
	SIM_CLK	O		Clock signal of the SIM card

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Function	Signal Name	I/O	Waveform and Level	Remarks
V)	VSIM	P	V_{oHmax} = 3.00 V V_{otype} = 2.90 V V_{oHmin} = 2.75 V	Power voltage of the SIM card
	GND			GND of the SIM card
SIM card interface (assuming the voltage is 1.8 V)	SIM_RST			Reset signal of the SIM card
	SIM_DATA			Data signal of the SIM card
	SIM_CLK			Clock signal of the SIM card
	VSIM		V_{oHmax} = 1.95 V V_{otype} = 1.80 V V_{oHmin} = 1.65 V	Power voltage of the SIM card
	GND			GND of the SIM card
UART1 communication interface	UART1_RD	O	V_{oLmax} = 0.10 V V_{oHmin} = 2.70 V V_{ILmax} = 0.40 V V_{IHmin} = 2.40 V V_{IHmax} = 3.30 V	This interface can be used to transmit AT commands and data.
	UART1_TD	I		
	UART1_RING	O		
	UART1_DSR	O		
	UART1_RTS	I		
	UART1_DTR	I		
	UART1_CTS	O		
	UART1_DCD	O		
Analog audio interface	EXTMIC_N	AI		Negative end of differential headset MIC input through channel 2
	EXTMIC_P	AI		Positive end of differential headset MIC input through channel 2
	INTMIC_P	AI		Positive end of differential handset MIC input through channel 1
	INTMIC_N	AI		Negative end of differential handset MIC input through channel 1
	EXTEAR_N	AO		Negative end of differential speaker output through channel 2
	EXTEAR_P	AO		Positive end of differential speaker output through channel 2
	INTEAR_P	AO		Positive end of differential speaker audio output through channel 1

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Function	Signal Name	I/O	Waveform and Level	Remarks
	INTEAR_N	AO		Negative end of differential speaker audio output through channel 1
NC pin	NC			Pins 9, 13, 15, 17, 19, 21, 26, 27, 30, 31, and 39 are internal pins. These pins need to be left floating when they are used.

NOTE
P indicates power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output; **AI** indicates pins for analog signal input; **AO** indicates pins for analog signal output.

5.5 Power Supply Features

5.5.1 Input Power Supply

Table 5-5 lists the requirements for input power of the MG323 module.

Table 5-5 Requirements for input power of the MG323 module

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
VBAT	3.3	3.8	4.8	V
VCOIN	2	3	3.15	V

5.5.2 Working Current

Table 5-6 lists the working current of the MG323 module.

Table 5-6 Working current of the MG323 module

Working Mode	Maximum Value	Unit
Power-off mode	47	μA
Standby mode	DRX = 2 I < 3.0	mA
	DRX = 5 I < 2.5	mA
	DRX = 9 I < 2.0	mA
GPRS mode	460	mA

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5.6 Reliability Features

Table 5-7 lists the test conditions and results of the mechanical reliability of the MG323 module.

Table 5-7 Test conditions and results of the mechanical reliability of the MG323 module

Item	Test Condition	Standard
Low-temperature storage	Temperature: –40 ºC ± 2ºC Test duration: 24 h	IEC60068
High-temperature storage	Temperature: 85 ºC ± 2ºC Test duration: 24 h	IEC60068
Low-temperature working	Temperature: –30 ºC ± 2ºC Test duration: 24 h	IEC60068
High-temperature working	Temperature: 75 ºC ± 2ºC Test duration: 24 h	IEC60068
Damp heat cycling	High temperature: 55 ºC ± 2ºC Low temperature: 25 ºC ± 2ºC Humidity: 95% Repetition times: 4 Test duration: 12 h + 12 h	IEC60068
Temperature shock	Low temperature: –40 ºC ± 2ºC High temperature: 85 ºC ± 2ºC Temperature change interval: < 30s Test duration: 15 min Repetition times: 100	IEC60068
Condensation test	Temperature: –40 ºC ± 2°C Time for keeping condensed: 2 h Recovery temperature: 25 ºC ± 2°C Recovery time: 5 min Repetition times: 6	IEC60068
Dust test	Dust density: 2 kg/m^3 Dust type: dry talcum powder Size requirement: < 75 μm Duration: 8 h	IEC60068
Salty fog test	Temperature: 35°C Density of the NaCl solution: 5±1% Spraying interval: 8 h Duration of exposing the module to the temperature of 35°C: 16 h	IEC60068

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Item	Test Condition	Standard
Sun exposure	Radiation strength: 1120 W/m^2 Duration: 20 h Repetition time: 3	IEC60068
Sine vibration	Frequency range: 5 Hz to 200 Hz Acceleration: 10 m/s^2 Frequency scan rate: 1 oct/min Test period: 3 axial directions. Five circles for each axial direction.	IEC60068
Shock test	Half-sine wave shock Peak acceleration: 300 m/s^2 Shock duration: 11 ms Test period: 6 axial directions. One shock for each axial direction.	IEC60068
Clash test	Half-sine wave Peak acceleration: 180 m/s^2 Pulse duration: 6 ms Repetition time: 6 directions. 1000 times for each direction.	IEC60068
Drop test	First case: 0.3 m in height. Drop the MG323 module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested. Second case: 0.8 m in height. Drop the MG323 module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested.	IEC60068

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5.7 ESD Features

CAUTION

Pay great attention to ESD protection when using the MG323 module. To ensure that the working reference GND is connected to the MG323 module and user interface board properly, you are recommended not to spray a coated insulation on the structure fixing hole (connecting with the main reference GND of the user interface board) and connect the hole with the MG323 module through the metal fastener or other low-resistance fastener. For specific installation method and fastener specification, see “6.4 MG323 Module Installation Description."

Table 5-8 lists the test results of the ESD performance of the MG323 module according to the EN61000-4-2 standard.

Table 5-8 ESD performance

ESD Test Standard	Contact Discharge	Air Discharge
EN61000-4-2	±4 kV	±8 kV

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6 Structure

6.1 Overview

This chapter describes the dimensions of the MG323 module, including:

- Dimensions
- Dimensions of the B2B Connector
- MG323 Module Installation Description
- Specification Selection for Fasteners

6.2 Dimensions

Dimensions (L x W x H): 35 mm ± 0.15 mm x 32.5 mm ± 0.15 mm x 3.05 mm ± 0.3 mm (the dimensions of the B2B connector are counted)

35 mm ± 0.15 mm x 32.5 mm ± 0.15 mm x 2.85 mm ± 0.20 mm (the dimensions of the B2B connector are not counted)

Figure 6-1 shows the dimensions.

Weight: 5.8 g

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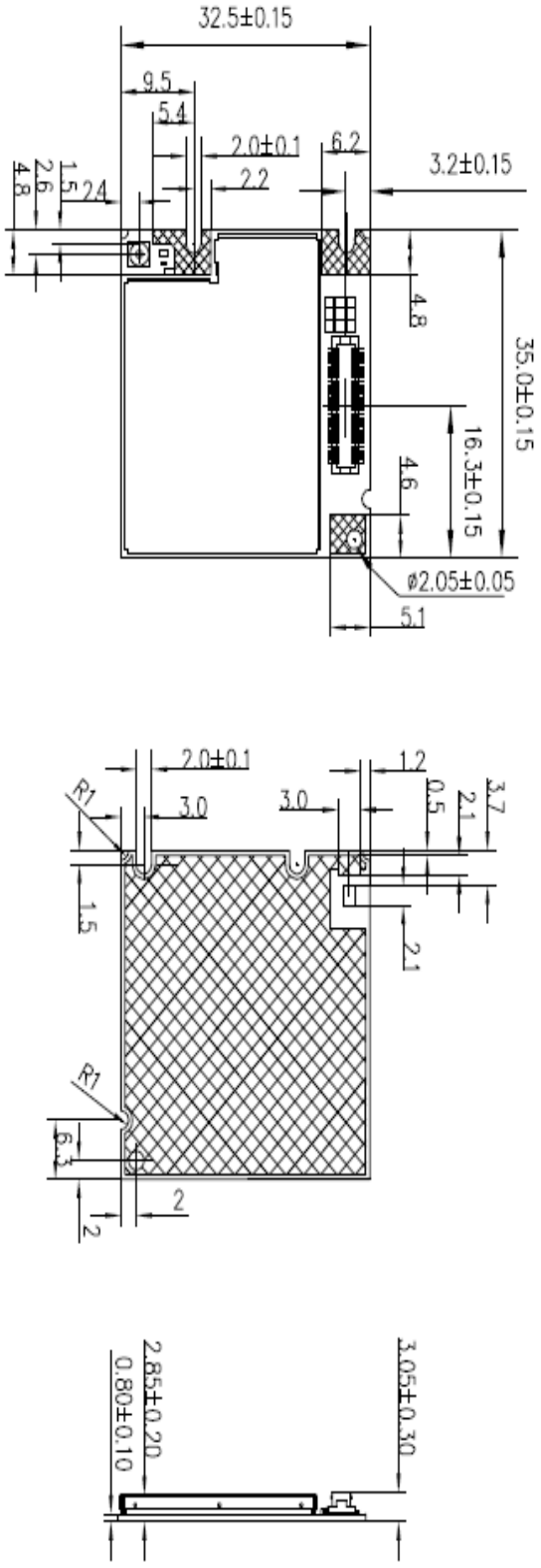
Figure 6-1 Dimensions of the MG323 module (unit: mm)



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6.3 Dimensions of the B2B Connector

The MG323 module uses the 50-pin B2B connector whose model is DF12C(3.0)-50DS-0.5V(81) and whose pin spacing is 0.5 mm to work with the connector DF12E (3.0)-50DP-0.5V (81) of the DF12 series (both connectors are manufactured by Hirose). For specific models, access http://www.hirose.com.

Figure 6-2 DF12C (manufactured by Hirose) used on the MG323 module

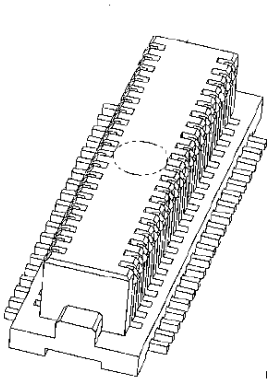

Figure 6-3 DF12E (manufactured by Hirose) recommended to be used with the MG323 module on the user interface board

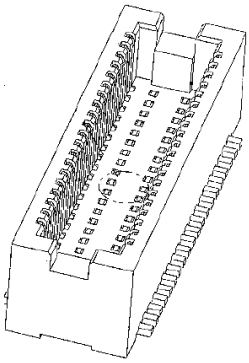

Table 6-1 Ordered connector model and DF12 product series working with the MG323 module

Item	Model	Stacking Height (mm)	HRS Number
Connector model used with the MG323 module	DF12C(3.0)-50DS-0.5V(81)	3.0	537-0694-9-81
Connector model recommended to be used on the user interface board	DF12E(3.0)-50DP-0.5V(81)	3.0	537-0834-6-**

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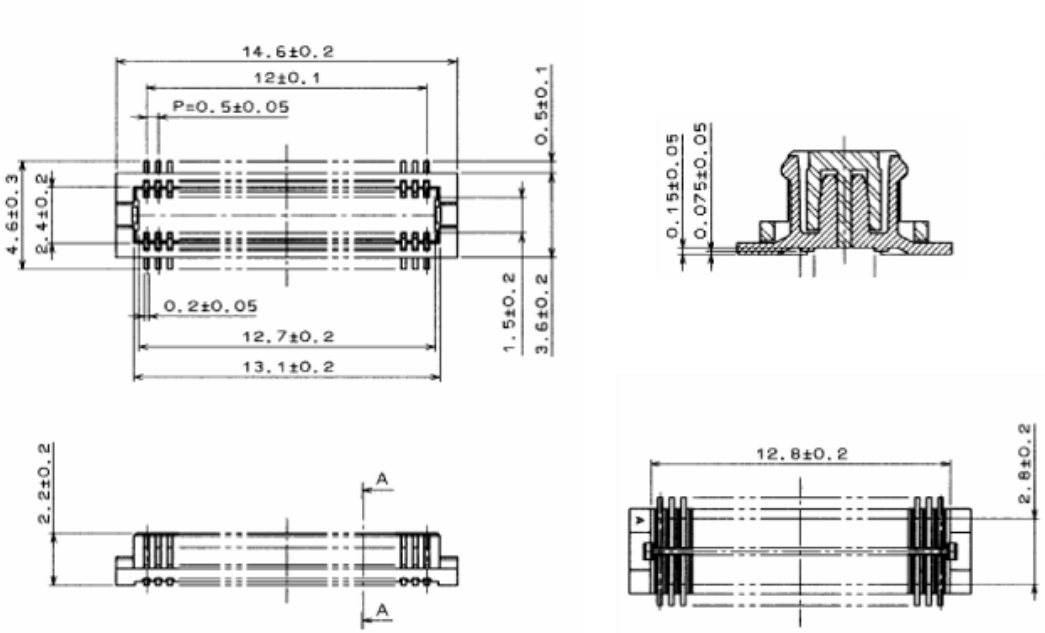
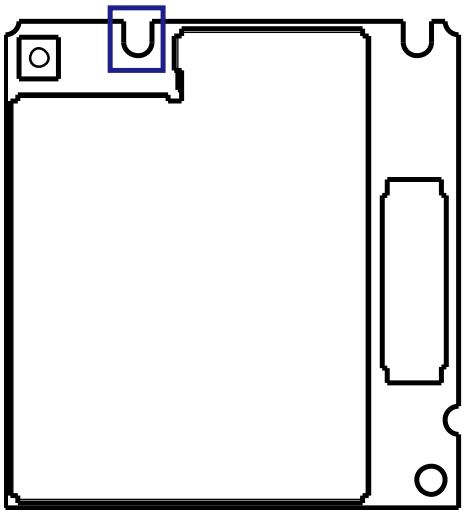
Figure 6-4 Dimensions of the connector used on the MG323 module (unit: mm)



6.4 MG323 Module Installation Description

Three structure fixing holes (diameter: 2 mm) are reserved in the MG323 module. The holes are not sprayed with a coated insulation and connected with the main reference GND of the module, as shown in Figure 6-5 .

Figure 6-5 Structure fixing hole



You can insert machine screws through the structure fixing holes and metal fasteners and fasten with nuts to firmly connect the MG323 module to the user interface board [1]. The metal fastener is placed between the MG323 module and user interface

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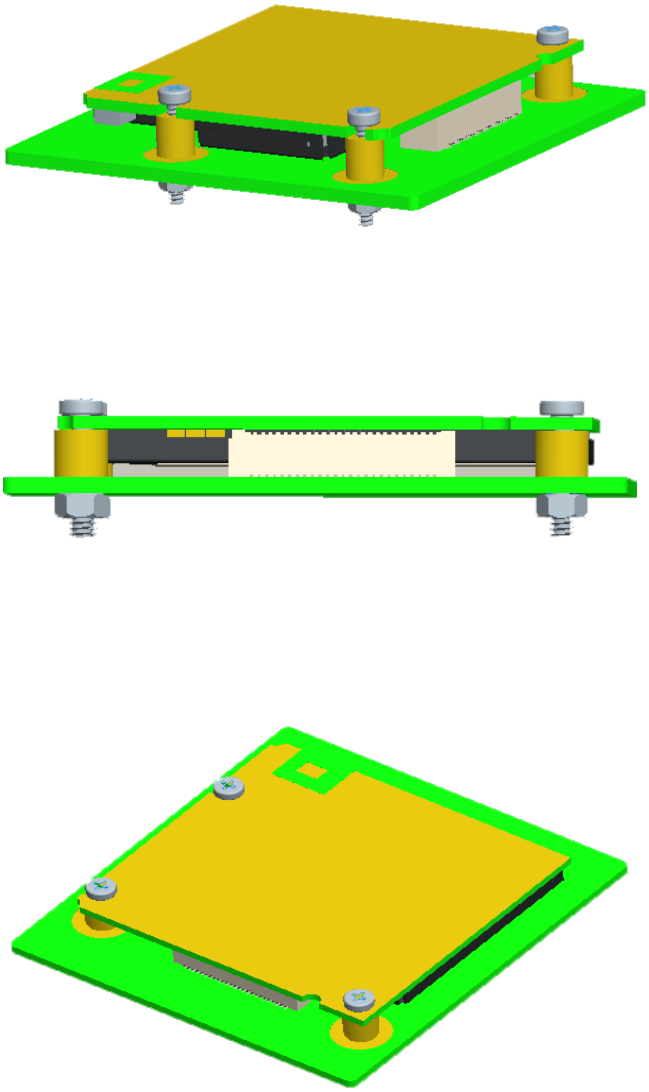
board and functions as a brace and connects the MG323 module and user interface board through the reference GND. Below the user interface board, the nuts are used to fasten the screws. Figure 6-6 shows the MG323 module installation.

Figure 6-6 MG323 module installation



NOTE

[1]: Pay great attention to ESD protection when using the MG323 module. To ensure that the working reference GND is connected to the MG323 module and user interface board properly, you are recommended not to spray a coated insulation on the structure fixing hole (connecting with the main reference GND of the user interface board) and connect the hole with the MG323 module through the metal fastener or other low-resistance fastener.

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6.5 Specification Selection for Fasteners

To ensure that the MG323 module is firmly fixed on the interface board when using the MG323 module, you are recommended to you use the M1.6 or M1.8 machine screw. You can also customize the screws. The fastener components in the following figures are recommended. The machine screw dimensions are M1.6×7.5×3.0×1.0. It is recommended that you plate gold on the metal fastener. Figure 6-7 shows the specific dimensions for the fastener components.

Figure 6-7 Machine screw dimensions

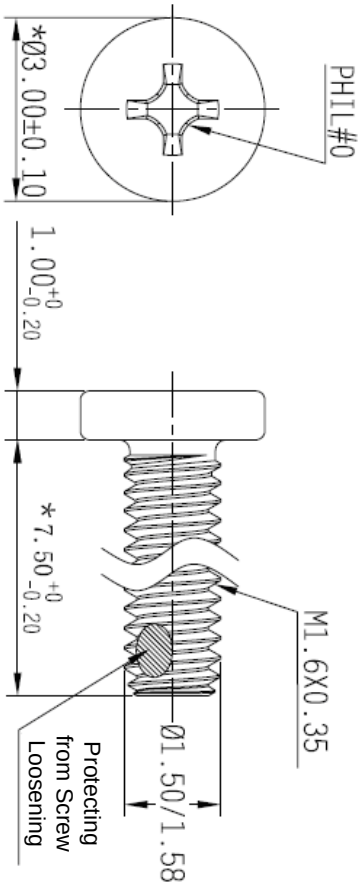

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Figure 6-8 Nut dimensions

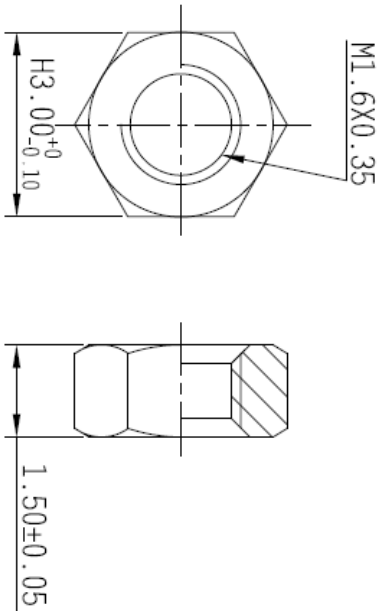
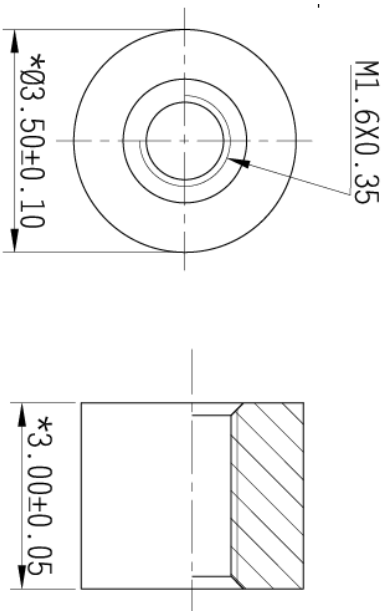


Figure 6-9 Metal fastener dimensions



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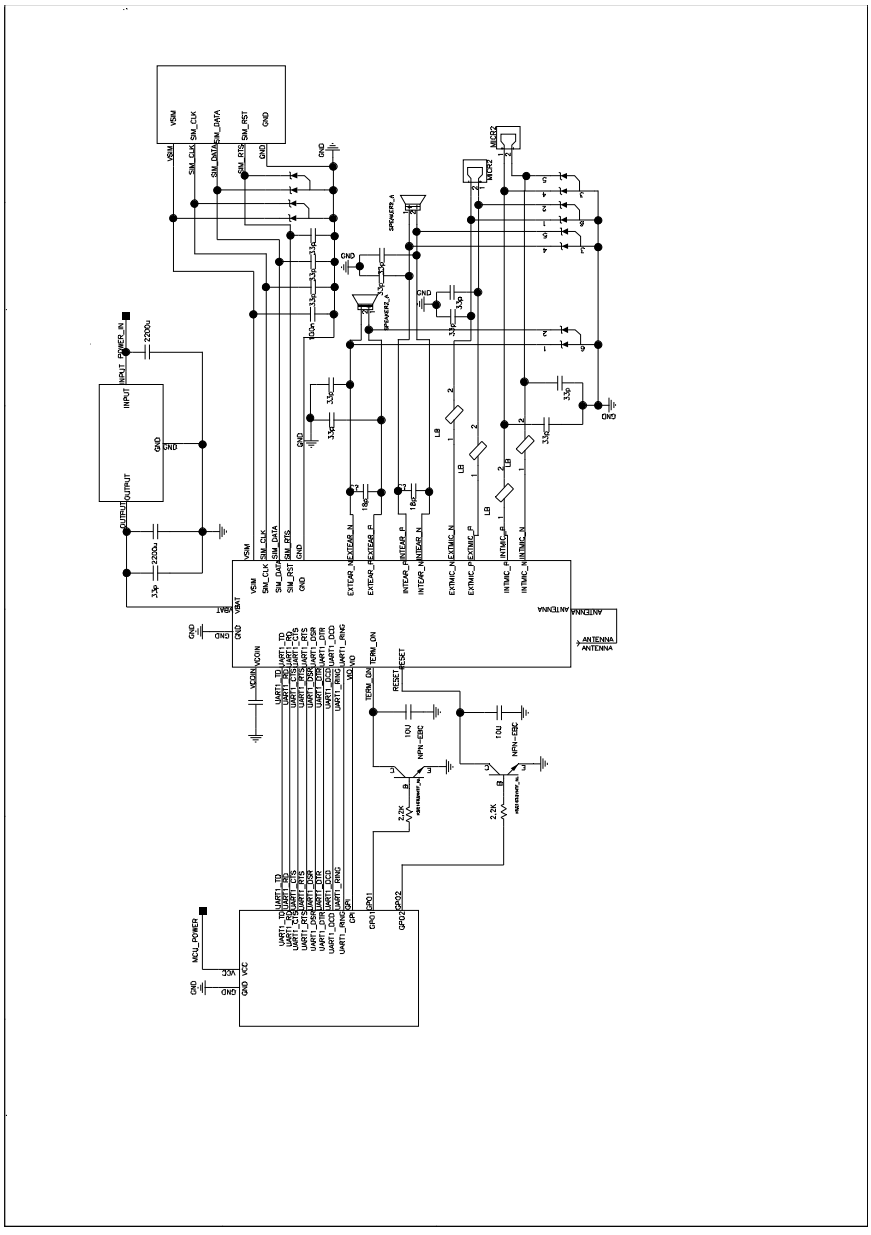
7 Appendix A Circuits of Typical Interfaces

Figure 7-1 Circuits of typical interfaces in the MG323 module



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8 Appendix B Acronyms and Abbreviations

Acronym or Abbreviation	Expansion
B2B	Board-to-Board
CE	European Conformity
CS	Coding Scheme
CSD	Circuit Switched Data
DC	Direct Current
DCE	Data Circuit-terminating Equipment
DMA	Direct Memory Access
DTE	Data Terminal Equipment
EIA	Electronic Industries Association
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Conformity
FCC	Federal Commnications Commission
FDD-TDMA	Frequency Division Duplexing–time Division Multiple Access
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
ISO	International Standards Organization
LCP	Liquid Crystal Polyester
LDO	Low-Dropout
LED	Light-emitting Diode
MCP	Multi-chip Package

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Acronym or Abbreviation	Expansion
NTC	Negative Temperature Coefficient
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PDU	Protocol Data Unit
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
RTC	Real-time Clock
SIM	Subscriber Identity Module
TTL	Transistor-transistor Logic
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver-transmitter
VSWR	Voltage Standing Wave Ratio

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